WHAT IS CLAIMED IS:

1. A holographic bar code symbol scanner comprising:

a laser diode having an inherent astigmatic difference, for producing a laser beam having astigmatism;

a holographic scanning disc rotatable about an axis of rotation and having one or more holographic optical elements supported thereon for scanning said laser beam and producing a laser scanning pattern for scanning code symbols within a 3-D scanning volume having a relatively large depth of field; and

astigmatism reduction means for substantially reducing said astigmatism prior to the passage of said visible laser beam through said holographic optical elements during laser scanning operations.

2. A holographic bar code symbol scanner comprising:

a laser diode for producing a laser beam having a plurality of spectral components;

a holographic scanning disc rotatable about an axis of rotation and having one or more holographic optical elements for scanning said laser beam and producing a laser scanning pattern for scanning code symbols; and

an optics assembly for effectively compensating for wavelength-dependent dispersion in the spectral output of said laser diode as said laser beam propagates from said laser diode through each said holographic optical element during scanning operations.

3. A holographic bar code symbol scanner comprising:

a laser diode for producing a laser beam having a plurality of spectral components;

a holographic scanning disc rotatable about an axis of rotation and having one or more holographic optical elements for scanning said laser beam and producing a laser scanning pattern for scanning code symbols; and

an optics assembly integrated with said laser diode for (i) controlling the aspect ratio of the laser

beam produced by said laser diode, (ii) eliminating astigmatism in said laser beam after transmission through said optic assembly, and compensating for wavelength-dependent variations in the spectral output of said laser diode.

4. A code symbol reading system comprising:

a first scanner is used to detect the location of a code symbol in a 3-D scanning volume; and

a second scanner is used to scan the location or region in which the code symbol is detected, to collect scan data for decode processing.

5. The code symbol reading system according to claim 4, wherein said first scanner is a holographic laser scanner.

6. The code symbol reading system of claim 5, wherein said second scanner is a 2-D type scanner.

7. A laser scanning system comprising:

means for producing a high-resolution 2-D scanning field; and

means for steering said 2-D scanning field within 3-D scanning volume.

8. A laser beam production module for producing a laser beam having a prespecified aspect ratio comprising:

a laser diode for producing a laser beam;

an aspheric lens;

a prism; and

a single-function light diffractive grating.

9. The laser beam production module of claim 8, wherein said single-function light diffractive grating is a holographic optical element.

10. A laser beam production module comprising:

a laser diode for producing a laser beam having asymmetrical beam cross-section and astigmatic beam characteristics;

an aspheric lens and a prism in proximity of each other for controlling the aspect ratio of said laser beam and eliminating said astigmatic beam characteristics of said laser beam beyond the prism; and

a light diffractive grating for reducing dispersion of the spectral components of said laser beam as said laser beam is transmitted through a holographic scanning disc during laser beam scanning operations.

11. A laser beam production module for use in a laser scanner having a holographic scanning disc, said laser beam production module comprising:

a laser diode for producing a laser beam having asymmetrical beam cross-section and astigmatic beam characteristics; and

an aspheric lens and a light diffractive grating in proximity of each other, for controlling the aspect ratio of laser beam and eliminating said astigmatic beam characteristics of said laser beam beyond said light diffractive grating, and reducing dispersion of the spectral components of the laser beam as the laser beam is transmitted through a holographic scanning disc during laser beam scanning operations.

12. A method of designing a laser beam optics module for use with a holographic scanning disc and a laser diode employed in a holographic laser scanner, said method comprising the steps of:

designing an optical assembly for (i) controlling the shape of the laser beam produced from said laser diode, (ii) eliminating the inherent astigmatic difference therein, and (iii) compensating for wavelength-dependent variations in the spectral output of the visible laser diode when said laser beam is transmitted through said holographic scanning disc.

13. Apparatus for use in configuring the parameters of a laser beam production module comprising:

an optical bench supportable relative to a stationary surface;

a fixture on said optical bench for supporting said laser beam production module;

quad-photodetector on said optical bench, for detecting the laser beam produced from said laser beam production module;

a beam scanner on said optical bench for measuring the beam cross-section of said laser beam along an optical axis defined with respect to said optical bench.

14. A holographic laser scanning system comprising:

a laser scanning disc with facets having dual-fringe contrast regions for optimized scanning and light collection operations.

15. A method of constructing a holographic scanning disc having one or more holographic facets, said method comprising the steps of:

(a) making the first portion of said holographic scanning facet with a first index modulation; and

(b) making the second portion of the scanning disc with a second index modulation which is different than said first modulation index.

16. A holographic laser scanner for producing a 2-D laser scanning pattern within a 3-D scanning volume, comprising:

a housing; and

holographic laser scanning means within said housing for producing a 2-D raster scanning pattern within a 3-D scanning volume, said holographic laser scanning means including

a holographic laser scanning disc rotatable about an axis of rotation,

laser beam producing means for producing a laser beam and directing said laser beam towards said holographic laser scanning disc at an angle of incidence with respect to said holographic laser scanning disc, and

angle of incidence varying means for varying said angle of incidence during laser scanning operations so that said 2-D raster scanning pattern is generated within a 3-D scanning volume.

17. The holographic laser scanner of claim 16, wherein said housing is hand-supportable.

18. The holographic laser scanner of claim 17, which further comprises means for automatically initiating laser scanning without the use of a manually-operable trigger.

19. A holographic scanning device for use in a holographic laser scanner to produce a plurality of scanlines, comprising:

a support disc rotatable about an axis of rotation, and having an inner perimeter, an outer perimeter, and an available light collecting region defined between said inner perimeter and outer perimeter; and

a plurality of holographic facets, each being supported on said support disc between the inner and outer perimeters, and each having a facet surface area light collecting operations and at least a portion of said facet surface area being disposed adjacent said outer perimeter of said support disc for laser beam scanning operations,

wherein the sum of all of the facet surface areas of said plurality of said holographic scanning facets is substantially equal to the surface area of said available light collecting region of said support disc.

20. The holographic scanning device of claim 19, wherein the refractive index of each said holographic facet has a variable spatial frequency over its facet surface area, providing a focal length which is related to the distance of the scanline to be produced by said holographic scanning facet.

21. The holographic scanning device of claim 19, wherein the light collection efficiencies of all of said holographic facets are substantially equal.

22. A holographic scanning device of claim 19, wherein the inner surface boundary of at least one of said holographic facets has an inner radius which is substantially greater than the inner perimeter of said support disc.

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23. The holographic scanning device of claim 19, wherein each said holographic facet is a volume transmission type hologram.

24. The holographic scanning device of claim 19, wherein each said holographic facet is a volume reflection type hologram.

25. The holographic scanning device of claim 19, wherein the average refractive index of each said holographic scanning facet is substantially equal over the entire facet surface area thereof.

26. The holographic scanning device of claim 19, wherein the outer portion of the facet surface area of each said facet used for scanning operations has a first average refractive index, whereas the remaining portion of the facet surface area of each said facet used for light collecting operations has a second average refractive index.

27. The holographic scanning device of claim 19, wherein said first average refractive index is different from said second average refractive index.

28. The holographic scanning device of claim 26, wherein the light diffraction efficiency of said outer portion of said facet surface area is optimized for a first polarization state of light, and the light diffraction efficiency of said remaining portion of said facet surface area is optimized for a second polarization state of light orthogonal to said first polarization state.

29. The holographic scanning device of claim 27, wherein said first polarization state is the S polarization state, and said second polarization state is the P polarization state.

30. A holographic laser scanning system comprising:

a housing; and

a laser scanning disc disposed within said housing, having holographic scanning facets with optimized light collection efficiency and a light collection surface area which is maximized with respect to the total surface area available for light collection.

31. A holographic laser scanner comprising:

a support disc rotatable about an axis of rotation, and having an inner perimeter, an outer perimeter, and an available light collecting region defined between said inner perimeter and outer perimeter; and

a plurality of holographic facets, each being supported on said support disc between the inner and outer perimeters of said support disc, and each having a facet surface area for use in light collecting operations,

wherein substantially all of the available light collecting surface area on said support disc is utilized and the light collection efficiency of each said holographic facet is substantially equal.

32. A holographic laser scanner comprising:

a laser for producing an outgoing laser beam;

a support disc having an axis of rotation, and an inner perimeter, an outer perimeter, and an available light collecting region defined between said inner perimeter and outer perimeter; and

a plurality of holographic facets, each being supported on said support disc between the inner and outer perimeters of said support disc, and each having a light collection area for use in light collecting operations,

wherein the size and shape of the light collection area of each holographic optical element is controlled independent of the angular sweep of said outgoing laser beam in order to make maximum use of the disk surface area for light collection functions during laser scanning operations.

33. A holographic laser scanner for producing a 3-Daser scanning volume, which comprises:

a housing having a scanning window;

a holographic laser scanning means for producing said 3-D laser scanning volume projected beyond said scanning window;

wherein said 3-D scanning volume is substantially greater than the volume of said housing, and provides full omni-directional scanning within said 3-D laser scanning volume.

34. The holographic laser scanner of claim 33, in which said 3-D laser scanning volume has multiple focal planes and a highly confined geometry extending about a projection axis extending from said scanning window.

35. A holographic laser scanner which comprises:

a scanner housing having an internal volume and a scanning window; and

a 3-D laser scanning volume produced from said scanner housing, wherein the ratio of said 3-D scanning volume to the volume of said scanner housing is greater than about 5.0.

36. The holographic laser scanner of claim 32, wherein said laser beam is a visible laser beam.

37. A holographic laser scanner comprising:

a plurality of lasers for simultaneously producing a plurality of laser beams; and

a scanning disc supporting a plurality of holographic facets for focusing and scanning said plurality of laser beams so as to produce a complex scanning pattern comprising a plurality of scanning planes within a 3-D scanning volume,

wherein said scanning planes have multiple focal regions, for scanning code symbols presented within said 3-D scanning volume; and

wherein the focal lengths of said multiple focal regions are selected so as to create an overlap at the ends of said scanning planes in the near and far regions of adjacent focal regions in said 3-D scanning volume,

thereby allowing a code symbol passed therethrough

to be scanned omnidirectionally within said 3-D scanning volume.

38. A holographic laser scanning system comprising:

a housing; and

means in said housing for producing overlapping astigmatic scanning planes within a 3-D scanning volume for omni-directional code symbol scanning within said 3-D scanning volume.

39. A holographic laser scanner for producing a complex laser scanning pattern consisting of a plurality of laser scanning planes each having a focal planes, said holographic laser scanner comprising:

a support disc rotatable about an axis of rotation, and having an inner perimeter, outer perimeter, and an available light collecting region defined between said inner perimeter and outer perimeter; and

a plurality of holographic facets, each being supported on said support disc between the inner and outer perimeters of said support disc, and each having a facet surface area for use in light collecting operations and at least a portion of said facet surface area being disposed adjacent said outer perimeter of said support disc for use in laser beam scanning operations,

wherein said holographic optical elements are arranged on said support disc to maximize the use of the space on said support disc for light collection, while minimizing the laser beam velocity at the focal plane of each of said laser scanning plane.

40. A holographic laser scanning system comprising:

a parabolic light collection mirror having an optical axis aligned off the Bragg angle of said holographic scanning facets.

41. A holographic laser scanning system comprising:

a laser scanning disc with holographic facets for collecting light rays reflected off a scanned code symbol;

a parabolic light focusing mirror disposed beneath

said laser scanning disc off the Bragg angle of said holographic facets, for focusing the reflected light rays collected by said holographic facets; and

a photodetector disposed above said laser scanning disc, for detecting the intensity of collected light rays focused by said parabolic light focusing mirror.

42. A holographic laser scanning system, comprising:

a laser scanning disc having a plurality of holographic facets disposed thereon for scanning an incident laser beam within said scanning field within a scanning field of 3-D volumetric extent, and for collecting light rays reflected off a scanned code symbol within said scanning field for subsequent focusing and detection;

a plurality of parabolic light reflective surfaces disposed beneath said laser scanning disc off the Bragg angle of said holographic scanning facets, for focusing towards a focal point above said laser scanning disc, the reflected light rays collected by each holographic facet; and

a plurality of photodetectors, each being disposed at said focal point above said laser scanning disc, radially aligned with one said parabolic light reflective surface, for detecting the intensity of collected light rays focused by said parabolic light reflective surface and transmitted through said holographic facet to said photodetector for detection and generating a scan data signal for subsequent processing;

wherein the light diffraction efficiency of each said holographic facet at the angle of incidence of said laser beam during said scanning is substantially greater than the light diffraction efficiency of the scanning of said focused laser beam are transmitted from said parabolic light reflective surface towards said photodetector during light detection.

43. The holographic laser scanning system of claim 42, wherein each said parabolic light reflective surface is realized as a parabolic mirror element having parabolic surface patch characteristics.

44. The holographic laser scanning system of claim 42, which further comprises a light polarizing filter disposed before said photodetector.

45. The holographic laser scanning system of claim 44, wherein the polarization state of said incident laser beam is S polarization, and the polarization state of said polarizing filter is P polarization state.

46. A holographic laser scanner comprising:

a plurality of laser diodes for simultaneously producing a plurality of laser beams;

a scanning disc rotatable about an axis of rotation, having an upper surface and a lower surface, and supporting a plurality of holographic facets therebetween for focusing and scanning said plurality of laser beams so as to produce a complex scanning pattern comprising a plurality of scanning planes within a 3-D scanning volume, for omnidirectionally scanning code symbols presented within said 3-D scanning volume; and

a plurality of light collection and detection subsystems, each said light collection and detection subsystem being arranged about said upper and lower surfaces of said scanning disc in order to collect and detect laser light reflected off a code symbol scanned by one said laser beam.

47. A holographic laser scanning system, comprising:

a laser scanning disc having a plurality of holographic facets disposed thereon for scanning an incident laser beam within a scanning field, and for collecting light rays reflected off a scanned code symbol within said scanning field for subsequent focusing and detection;

a light focusing mirror disposed beneath said laser scanning disc, for focusing towards a focal point above said laser scanning disc, the reflected light rays collected by each holographic facet; and

a photodetector disposed at said focal point above said laser scanning disc, for detecting the intensity of

collected light rays focused by said light focusing mirror and transmitted through said holographic facet to said photodetector for detection and generating a scan data signal for subsequent processing;

wherein the light diffraction efficiency of each said scanning facet at the angle of incidence of said laser beam during said scanning is substantially greater than the light diffraction efficiency of the scanning of said focused laser beam are transmitted from said light focusing mirror towards said photodetector during light detection.

48. The holographic laser scanning system of claim 47, which further comprises a light polarizing filter disposed before said photodetector.

49. The holographic laser scanning system of claim 48, wherein the polarization state of said incident laser beam is S polarization, and the polarization state of said polarizing filter is P polarization state.

50. A holographic laser scanner comprising:

a scanner housing having width, length and height dimensions, and a scanning window;

a plurality of lasers beam sources for producing a plurality of laser beams;

a holographic scanning disc, rotatable about an axis of rotation, and supporting a plurality of holographic facets for scanning and focusing said plurality of laser beams so as to produce a plurality of scanning planes;

a plurality of beam folding mirrors disposed about said holographic scanning disc, for folding said plurality of scanning planes so as to project a complex scanning pattern through said scanning window, for intersection within the spatial boundaries of a predefined 3-D scanning volume; and

a plurality of light collecting mirrors disposed beneath said holographic scanning disc,

wherein the geometrical dimensions of said beam folding mirrors in conjunction with the geometrical dimensions of said holographic scanning disc determine the

width and length dimensions of said scanner housing, and

wherein said geometrical dimensions of said beam folding mirrors and parabolic light collecting mirrors beneath said holographic scanning disc determine the height dimension of said scanner housing.

51. The holographic laser scanner of claim 50, wherein each said laser beam source comprises a laser diode, and wherein said holographic laser scanner further comprises a photodetector arranged with each said light collecting mirror for producing scan data signals.

52. The holographic laser scanner of claim 51, which further comprises an independent signal processing channel for each said laser diode and photodetector subcombination in order to improve the signal processing speed of system.

53. The holographic laser scanner of claim 50, which further comprises a plurality of signal processors for simultaneously processing the scan data signals produced from each of said photodetector within said holographic laser scanner.

54. A holographic laser scanner comprising:

a laser diode for producing a laser beam;

a holographic scanning disc, rotating about an axis of rotation, and supporting a plurality of holographic facets for focusing and scanning said laser beam by way of diffraction by said holographic facets, and therewhile encoding the zero-th diffraction order of said diffracted laser beam while being transmitted through said holographic facets during laser scanning operations; and

detection means for detecting said zero-th diffraction order of said diffracted laser beam so as to determine which holographic facets produce which scanning planes so that scan data collected from said scanning planes can be selectively filtered during symbol decoding operations.

55. The holographic laser scanner of claim 53, wherein said

zero-th diffractive order of said diffracted laser beam passes through the holographic optical elements on said holographic scanning disc and produces a start/home pulse for use with stitching-type or other-type decoding processes carried out in connection with said holographic laser scanner.

56. A holographic laser scanning system comprising:

a housing;

a holographic scanning disc disposed within said housing, rotating about an axis of rotation, and supporting a plurality of holographic facets for focusing and scanning a laser beam by way of diffraction by said holographic facets

a photodetector disposed in said housing;

a cross-polarization filter disposed before said photodetector; and

wherein the holographic facets supported on said holographic scanning disc are optimized to said polarization filter.

57. A holographic laser scanner comprising:

a support disc rotatable about an axis of rotation, and having an inner perimeter, an outer perimeter, and an available light collecting region defined between said inner perimeter and outer perimeter; a laser light source for producing a laser light beam having first and second components characterized by first and second polarization states, respectively, said first polarization state being orthogonal to said second polarization state;

a plurality of holographic facets, each being supported on said support disc between the inner and outer perimeters of said support disc, and having a beam steering portion disposed adjacent said outer perimeter for scanning said laser beam across a code symbol, and a light collecting portion for light collecting laser light reflected of said scanned code symbol,

wherein said beam steering portion of each said holographic facet is provided with a light diffraction

efficiency that is optimized for the first polarization state of said laser beam incident thereon, and said light collecting portion of each holographic facet has a light diffraction efficiency optimized for the second polarization state of laser light reflected off said scanned code symbol;

a photodetector for detecting laser light reflected off said code symbol; and

a polarization-selective filter disposed before said photodetector for transmitting collected laser light having said second polarization state and blocking collected laser light having said first polarization state.

58. A holographic laser scanner for producing a plurality of scanning planes each having a particular depth of focus and spatially confined within a 3-D omnidirectional, geometrically well-defined 3-D scanning volume, comprising:

a plurality of symmetrically arranged laser diodes for simultaneously producing a plurality of laser beams;

a plurality of holographic optical elements of the volume-transmission type for focusing and scanning said plurality of laser beams through said 3-D scanning volume, wherein each said holographic optical element is supported upon a rotatable disc and produces one of said plurality of scanning planes when one said laser beam passes through the holographic optical element during the operation of the holographic laser scanner.

59. A holographic laser scanning system comprising:

a housing; and

a holographic laser scanning subsystem disposed within said housing, for producing outside of said housing an omni-directional laser scanning field within a geometrically well-defined 3-D scanning volume.

60. The holographic laser scanning system of claim 59, wherein said geometrically well-defined 3-D scanning volume is in the shape of a 3-D polygonal shaped object.

61. The holographic laser scanning system of claim 59, wherein said 3-D polygonal shaped object has at least four substantially rectangular shaped side surfaces.

62. A holographic laser scanning system for producing an omnidirectional laser scanning pattern within a highly defined 3-D scanning volume projected above a worksurface, comprising:

a housing;

a laser scanning means disposed within said housing, for producing an omnidirectional laser scanning pattern within a highly defined 3-D scanning volume projected above a worksurface;

wherein said laser scanning means includes

one or more laser diodes for producing one or more laser beams, and

a holographic laser scanning disc rotatable about an axis of rotation, for scanning said one or more laser beams within said 3-D scanning volume.

63. A holographic laser scanning system comprising:

a housing;

a holographic scanning disc disposed within said housing, having reflection-type volume holograms as laser beam scanning elements and being rotatable about an axis of rotation; and

a light collection and detection subsystem disposed above said holographic scanning disc.

64. A holographic laser scanner for generating a complex scanning pattern having multiple scanning planes during a scanning pattern generation cycle, comprising:

a scanner housing having an apertured scanning window;

a plurality of lasers for simultaneously producing a plurality of laser beams;

a rotating disc supporting a plurality of holographic facets for focusing and scanning said plurality of laser beams so as to produce a complex scanning pattern

having multiple scanning planes; and

wherein said apertured scanning window allows simultaneously projection of said multiple scanning planes, at angles which differ from each other over the duration of each scanning pattern generation cycle.

65. A method of designing a holographic laser scanner having a predetermined laser scanning pattern comprising the steps of:

(a) determining the sizes and shapes of the holographic facets of said holographic scanning disc;

(b) using a surface geometry program to create a geometrical model of the components of said holographic laser scanner and said laser scanning pattern; and

(c) using a spreadsheet modelling program to create an analytical model for said holographic laser scanner and said laser scanning pattern.

66. A method of designing a holographic laser scanner comprising the steps of:

(a) specifying a scanner housing with a minimum height (i.e. depth) dimensions for a given three-dimensional laser scanning pattern confined within a specified scanning volume during bar code symbol reading operations.

67. A workstation for designing a holographic laser scanner supporting a scanline production process within a 3-D scanning volume, said workstation comprising:

means for modelling the geometry of the scanning pattern of said holographic laser scanner; and

means for producing an analytical model of said scanline production process of said holographic laser scanner.

68. A method of designing a holographic scanning disc for use in a holographic laser scanner capable of producing a prespecified laser scanning pattern from a scanner housing having the heightwise, lengthwise and widthwise dimensions, said method comprising the steps of:

(a) employing a spreadsheet-type computer program

to create an analytical model of the process of generating said prespecified laser scanning pattern using a prespecified holographic facet support disc and beam folding mirror arrangement; and

(b) computing an optimal set of holographic facet parameters which, for a holographic facet support disc of a prespecified size, minimizes the heightwise, lengthwise and widthwise dimensions of said scanner housing.

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